NASA SP-5923 (01)

PACKAGING AND CONTAINER TECHNOLOGY

A COMPILATION

TECHNOLOGY UTILIZATION OFFICE 1970
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D.C.

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Foreword

The National Aeronautics and Space Administration and Atomic Energy Commission have established a Technology Utilization Program for the dissemination of information on technological developments which have potential utility outside the aerospace and nuclear communities. By encouraging multiple application of the results of research and development, NASA and AEC earn for the public an increased return on the investment in aerospace and nuclear research and development programs.

This publication is part of a series intended to provide such technical information. Containers and packaging assemblies are discussed in terms of direct practical application by the user. Information regarding durability, ease of handling, weathering, and other pertinent topics afford the reader beneficial suggestions for improving his operations and reducing costs.

Additional technical information on individual devices and techniques can be requested by circling the appropriate number on the Reader's Service Card included in this compilation.

Unless otherwise stated, NASA and AEC contemplate no patent action on the technology described.

We appreciate comment by readers and welcome hearing about the relevance and utility of the information in this compilation.

Ronald J. Philips, *Director*
Technology Utilization Office
National Aeronautics and Space Administration

Contents

Section 1. Packaging Techniques and Assemblies

PACKAGING CRITERIA FOR MATERIEL IN TRANSPORTATION AND STORAGE OPERATIONS

The shock and vibration to which items are exposed during shipment and in storage and general handling operations can be severe and damaging. Design engineers and packaging specialists, in designing containers, and packaging and isolation systems to protect the items from damage, are concerned with detailed information of the relative fragility of typical items, and the hazards to which they will be exposed.

A comprehensive literature survey has been conducted to assemble data applicable to shock and vibration and their effects on items of materiel in transportation and handling operations. Approximately 150 reports and articles were reviewed, and more than 50 agencies concerned with the problem were contacted. A handbook based on this study has been prepared and was published in 1967. This publication is entitled "Transportation and Handling Shock and Vibration Design Criteria Manual, MR1262." It should be of value to packaging and design engineers as either background and reference material or as a training aid.

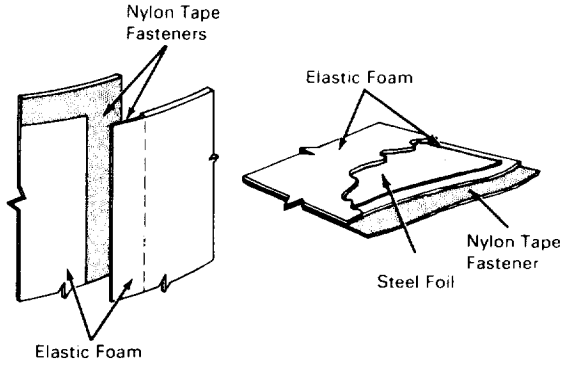
Source: Fred E. Ostrem and M. L. Rumerman of
General American Transportation Corp.
under contract to
Marshall Space Flight Center
(MFS-13007)

Circle 1 on Reader's Service Card.

IMPACT-AND PUNCTURE-RESISTANT COVERING MATERIAL PROTECTS PARTS FROM DAMAGE

A lightweight covering material has been developed that will protect delicate parts and equipment from damage during transportation and storage. It consists of sheets of steel foil bonded between sheets of elastic foam, and laminated in panels of uniform size. The edges of the panels are covered with adhesive-coated nylon tape to enable joining individual panels into a protective blanket or enclosure, of any size and shape. Panels of the material may be stored flat or in rolls.

The laminated foam and steel-foil construction of each panel gives the material its qualities of impact absorption and puncture resistance. Lateral components of forces contacting a panel surface are transmitted through the elastic skin to adjacent areas of the panel where they are dissipated. Orthogonal components of forces on the outer skin are transmitted to the steel-foil core, whose bearing strength is supported by the elastic skin on the opposite face of the panel. This skin transmits the forces elastically as distributed loads on the enclosed part.



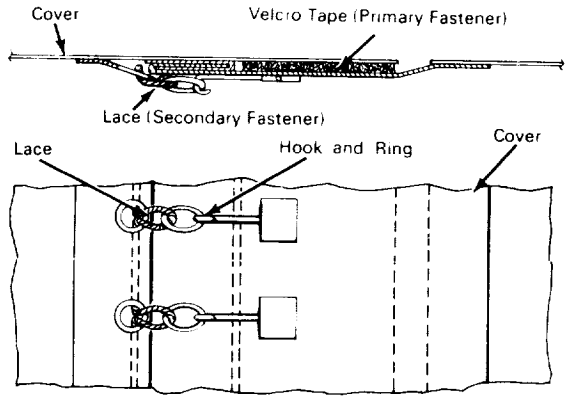
In addition to protecting equipment from damage by impact and puncture, enclosures of this material provide a barrier against moisture and thermal shock. Individual panels can also be removed easily from an enclosure to expose selected portions of equipment for inspection.

Source: Don D. Sheriff of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-90747)

Circle 2 on Reader's Service Card.

PROTECTIVE COVERS FOR BULKY DELICATE EQUIPMENT

Protective covers of Hereulite-impregnated material and a combination of Velcro, zipper, and hook-and-ring lacing closures have been used successfully in handling and transporting large items of delicate equipment without damage. The tough Hereulite material and the Velcro tape closures can be adjusted to provide a contour-hugging, snugly fitting cover that gives maximum protection from such hazards as wind, dust, sandstorm, rain, snow, and salt spray, and resist abrasion from handling. Another feature of the cover is its flexibility in affording easy access to hoisting and supporting rings and other protrusions on the equipment through pocket flaps, thereby facilitating hoisting, maneuvering, and positioning the equipment, and at the same time adequately protecting it. This advantage is achieved by a combination of primary and secondary fasteners as illustrated in the figure. The Velcro tape with its cocklebur action holds securely while the windproof wrapping



is applied. The secondary nylon-cord lacing completely secures the closure.

Source: D. J. Enrico of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-91921)

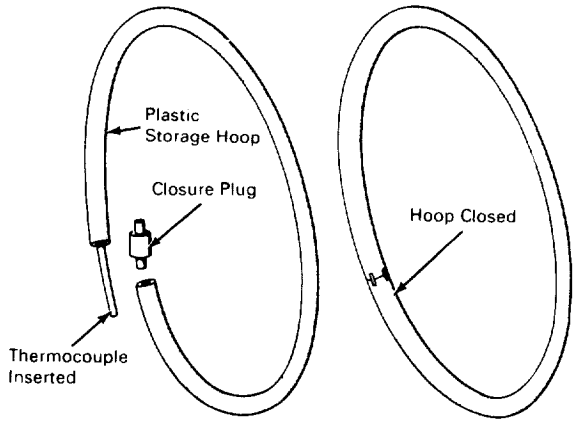
Circle 3 on Reader's Service Card.

HOLLOW PLASTIC HOOPS FOR PACKAGING THERMOCOUPLES

Hollow plastic hoops or rings have been found effective in protecting thermocouples and their leads from damage in handling during storage and shipping operations. Plastic bags for this purpose have been unsatisfactory, because they offer little protection for the long brittle leads, which are susceptible to breakage when they are bent beyond a certain radius.

As shown in the sketch, the hoop is cut at one point and the entire thermocouple assembly is inserted. Excess plastic hoop material is removed, and a closure plug of either wood, plastic, or metal is used to seal the open ends and reform the loop. The diameter of the hoop will depend upon the length of the leads and tolerable bending radii. Different colored hoops may be used to identify the various types of thermocouples that are enclosed.

This packaging technique is effective and inexpensive (one dollar or less per device). Thermocouples cost from $15 to $30 each.

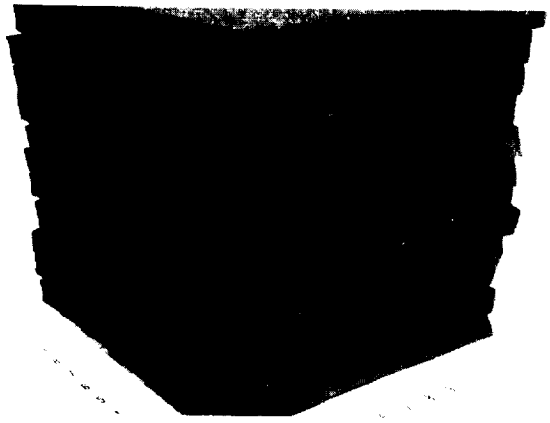


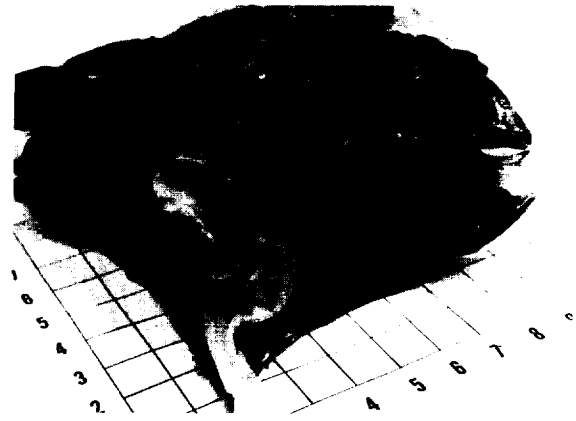
Hollow Plastic Hoops Protect Thermocouples

Source: L. H. Osmond of
Westinghouse Astronuclear Laboratory
under contract to
Space Nuclear Propulsion Office
(NUC-0023)

Circle 4 on Reader's Service Card.

PACKAGING AND COMPRESSING RUBBER AND PLASTIC FOAMS FOR SHIPMENT AND STORAGE





Rubber and plastic foams occupy inordinately large amounts of space in transportation and storage, and large packages of such materials, although light in weight, are awkward and difficult to handle. A novel method has been devised by which foams can be packaged and compressed to reduce the space required for storage and shipment and to facilitate handling.

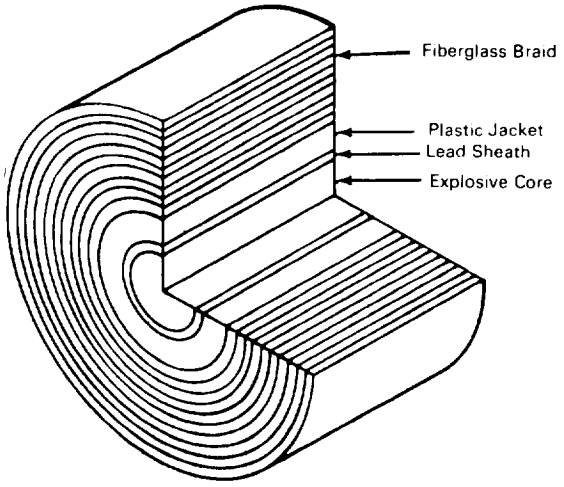
The package consists of an airtight polyethylene bag of suitable size in which the material is placed. A vacuum pump is used to evacuate air from the bag, thereby compressing the foam in the manner illustrated by the figures. With this technique, packages of foam can be reduced in size by as much as 90% or more, depending on the density of the foam being compressed.

Costs of shipping and storage of foam products, especially in large quantities, can be significantly reduced by this process. The method should be of interest to manufacturers and dealers concerned with shipping and storing large quantities of foam materials.

Source: P. C. Madvig and G. J. Pullon, Jr. of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18890)

Circle 5 on Reader's Service Card.

IMPROVED CONFINED DETONATING FUZE ASSEMBLY



A plastic sheath has been incorporated in the design of a confined detonating fuze (CDF) assembly to provide additional protection against the damaging and hazardous effects of friction and vibration. The CDF, consisting of a mild detonating fuze encased in lead and covered with multilayered fiberglass braid, is a device for transmitting detonating waves between ordnance components. The added sheath is composed of smooth plastic, such as polyethylene, with low frictional properties. It acts as a buffer between the lead-encased explosive core and the multilayered fiberglass outside

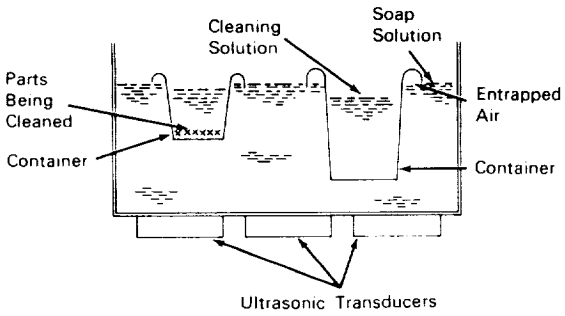
cover of the CDF, making the entire assembly more reliable, more resistant to damage from vibration and abrasion, and safer to handle. This improvement should be beneficial in civil and mining engineering and in any application in which explosives are employed.

Source: Arthur S. Eckstein of
Space Division
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16115)

No further documentation is available.

Section 2. Containers and Related Devices

SELF-SUPPORTING CONTAINER FOR USE IN ULTRASONIC CLEANING TANKS: A CONCEPT



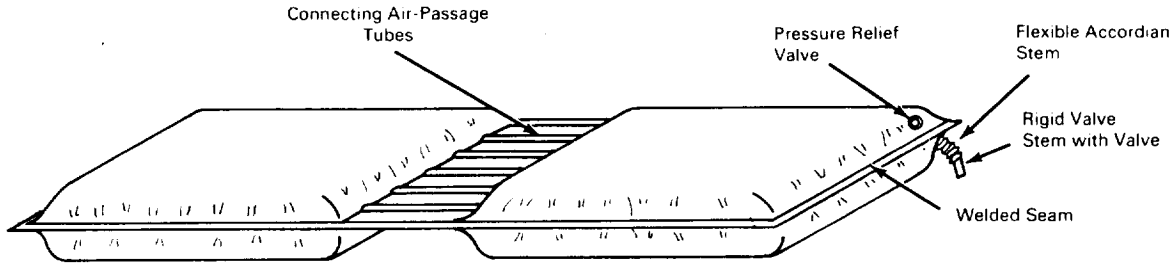
A glass or metal container having an open top with a deep recurved lip around its circumference can be used effectively in isolating parts in an ultrasonic cleaning bath. Placing the container and its contents in a liquid-filled ultrasonic cleaning tank will cause air to be trapped under the recurved lip, thus providing sufficient buoyancy and stability to float the container without any additional support. The features of compactness and self-support in this device will increase the capacity of the ultrasonic tank. In addition, by eliminating support structures, which absorb part of the energy output, more effective cleaning is possible.

A cross-sectional view of two typical containers suspended in an ultrasonic cleaning tank is shown in the figure. Because ultrasonic impulses are quite evenly distributed over the entire area of the tank, the cleaning actions is effective regardless of the container's position relative to the transducer.

Source: John W. Anderson of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-10712)

Circle 6 on Reader's Service Card.

AIR-PILLOW-PACK SHIPPING AND STORAGE CONTAINER



A system of packaging has been devised for protecting sensitive instruments, other fragile items, and explosives from hazards encountered in handling, stacking, and shipping. It consists of an impact-resistant container within which an air-pillow pack holds the item in suspension and keeps it relatively free from damage by impact, vibration, and shock.

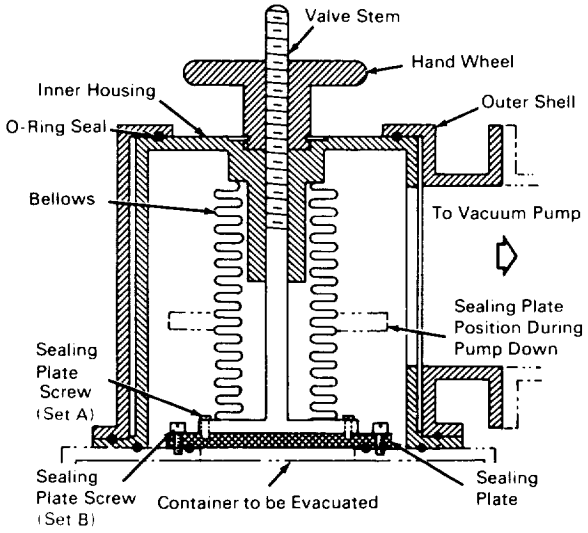
The container is a rectangular box of impact-resistant plastic with a lid secured by fasteners and stacking grooves on the top and bottom. The air-pillow pack, illustrated in the figure, consists of two semi-flat inflatable sections of 20- to 25-mil polyethylene, with interconnecting air-passage tubes. One section of the pillow pack is laid in the container, and the fragile item is placed on top of it. The other section of the pack is laid over the item, and the valve stem is passed through the accommodating hole of the plastic container and retained by a keeper. The lid of the container is then closed, the fasteners secured, and the air-pillow pack inflated through the valve stem. In this manner, the air-pillow pack completely envelopes the item. Depending upon the mass and the bearing surface area of the item placed in the container, a regulated air pressure of from 4 to 10 psig is estimated to be sufficient for securing the item in suspension between the two sections of the air pillow.

This packaging device should be ideal for both air freight and surface transportation. A pressure-relief valve is provided to prevent over pressures. The outer container will confine the air pillow under all anticipated variations of air pressure resulting from changes in altitude by the carrier.

Source: William J. Smith of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18111)

Circle 7 on Reader's Service Card.

SEAL-OFF DEVICE FOR EVACUATING AIR FROM CONTAINERS



A special seal-off assembly has been developed by which containers can be rapidly evacuated and effectively sealed. Features of the device include the use of large-diameter tubing, a readily sealable container vacuum port, and a reusable vacuum seal.

The seal-off assembly is attached to the container and sealed as illustrated in the sketch. The outer shell is removed to give access to the sealing-plate screws through openings in the inner housing. The screws (Set B) are removed, and the sealing plate is retracted from the container by turning the handwheel, which lifts the valve stem and compresses the bellows. The O-ring seal between the sealing plate and the container is a part of the sealing plate and is withdrawn with the plate. The outer shell is then replaced, and the large-diameter throughpath, completely sealed from the atmosphere, is available for the vacuum-pumping procedure.

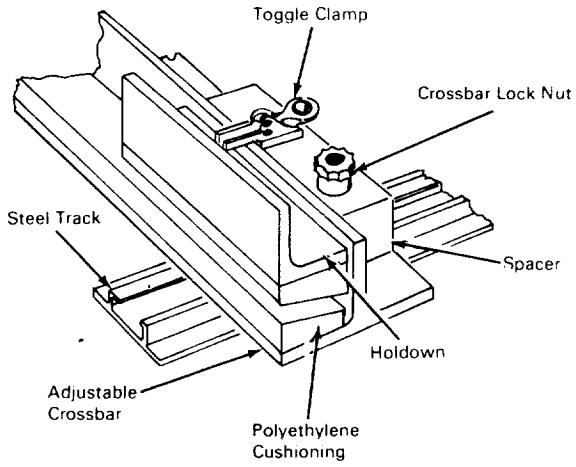
When the desired level of vacuum in the container has been reached, the sealing plate is lowered until a seal is established with the container. Atmospheric pressure may now be admitted into the seal-off assembly without disturbing the vacuum in the container. The outer shell can then be removed, the sealing-plate screws (Set B) inserted and tightened, and the screws (Set A) disengaged to allow complete removal of the seal-off assembly except for the sealing plate.

If the need for evacuating the container occurs again, the operation can be easily repeated using the same sealing plate.

Source: Robert R. Demers of
Astro-Electronics Division of RCA
under contract to
Goddard Space Flight Center
(GSC-00513)

No further documentation is available.

"VARITAINER"—A REUSABLE CONTAINER WITH ADJUSTABLE HOLD-DOWN DEVICE



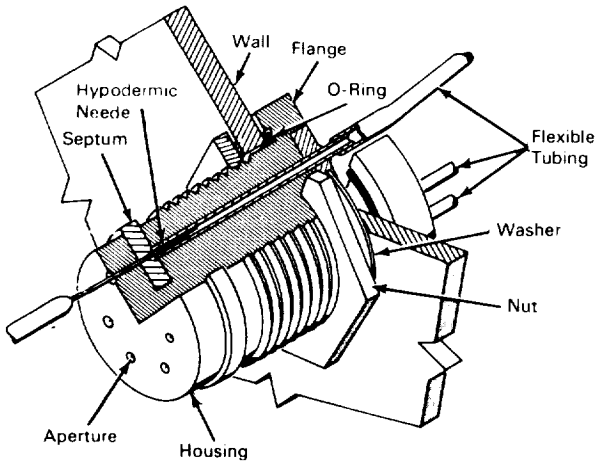
The "Varitainer" is a versatile reusable container, which was initially designed to protect spacecraft precision panels of varied size and shape from damage during intraplant and interplant handling and storage. By means of a unique application of standard hardware, the container is constructed to provide adjustability and adaptability to multipurpose uses, thereby obviating the need to design and build special-purpose containers for individual panels and similar structures.

Two tracks of fabricated steel are installed lengthwise in the bottom of a plywood container. An adjustable jaw-type cushioned hold-down device slides on the track and is locked in position with bolts and lock nuts. The top jaw can be opened and closed by means of quick-acting toggle clamps mounted on the crossbar. Polyethylene foam cushioning is bonded to both top and bottom jaws where they contact the panels. In use, the cushioned jaw-type hold-down is so positioned on the track as to fit the panel to be secured, and is locked in place. The toggle clamps are opened, the panel is placed on the lower jaws of the hold-down, and the toggle clamps are again locked. The container can then be closed and secured.

Source: L. C. Miller and C. R. Blomquist of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-11299)

Circle 8 on Reader's Service Card.

SELF-SEALING CLOSURE ENABLES ACCESS TO SEVERAL FLUID CONTAINERS



A self-sealing closure has been devised for withdrawing from or adding to the contents of several containers arranged in a relatively inaccessible or small space. It was initially designed to dispense small quantities of either biochemical solutions under sterile conditions or other liquids that must be protected from the atmosphere. The device is essentially an assembly incorporating a self-sealing septum of a silicone elastomer through which a hypodermic needle can be inserted in line with any one of several small-diameter tubes connected to individual containers.

As illustrated, the closure is inserted through a wall opening of a compartment in which the containers are located, and secured in a fluid-tight position by means of the nut, washer, and O-ring. Several tubes (one tube for each container in the group) are positioned in the closure assembly and extended beyond an undercut groove in which the septum is seated. Apertures of different diameters (to aid in identifying the respective containers) are drilled into the base of the housing concentrically with the respective tubes. The ends of the

tubes, which extend from the housing, are connected individually by flexible plastic tubing to the associated containers. When the hypodermic needle is withdrawn, after each addition or removal of liquid, the septum seals itself.

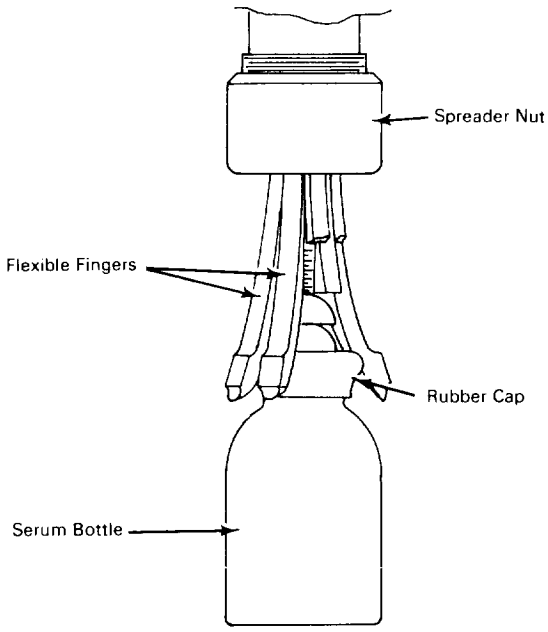
This device may possibly have application in surgical procedures involving the artificial kidney and blood-bypass techniques.

Source: Sam B. Wheeler
NASA Pasadena Office
(NPO-10123)

Circle 9 on Reader's Service Card.

SERUM BOTTLE CAPPER

A novel bottle capper has been developed for affixing flexible rubber caps on bottles containing serums. It is designed both to insert bottle stoppers expeditiously and to protect workers engaged in bottling radioactive liquids and other potentially dangerous fluids. The flexible rubber caps used with this device are commercially available. Each cap has a central stopper with a flexible seal that expands to fit over the neck of the bottle and seal it. The capper consists of a ring of flexible fingers that fit inside the seal. When downward pressure is applied, the fingers spread and expand the rubber cap, thus fitting the seal over the mouth of the bottle. The fingers and spreader nut can be changed to accommodate different sizes of caps. When dangerous liquids are bottled, the entire mechanism can be controlled remotely.

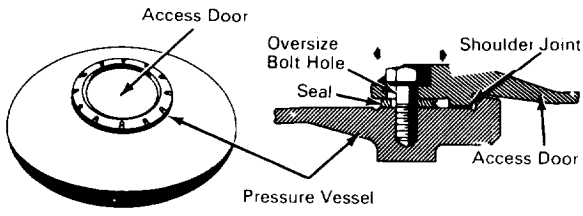


The device should be useful in the chemical and drug industries, and in laboratories and work areas of experimental research.

Source: W. D. Abram of
Lawrence Radiation Laboratory
University of California
Berkeley, California 94720
(LRL-10012)

Circle 10 on Reader's Service Card.

LIGHTWEIGHT ACCESS DOOR FOR PRESSURE VESSELS



A lightweight removable access door with an effective seal has been devised for spherical and semispherical pressure vessels containing cryogenic fluids. It will be as strong as the skin of the vessel itself, and will tolerate the deflections caused by large variations in temperature and load. Prior devices of this sort had precision-machined bolts and bolt holes, which were designed to carry tension, shear, and moment loads; consequently, manufacturing and installation requirements were severe.

As indicated in the figure, this design incorporates an overlocking joint and oversize bolt holes, so that the attaching bolts are in tension only. Shear and moment loads are supported by the joint's overlocking configuration. The door is

held in place and sealed by the tension bolts in recessed sockets. It has an internal shoulder or ridge that is slightly smaller than a mating shoulder at the periphery of the pressure vessel opening. All horizontal loads caused by pressure are transmitted through the joint in shear, and the tension bolts are relieved of this loading by the oversize holes in the door. As pressure or thermal loads decrease, the joint tends to open, but sealing is maintained by action of the tension bolts on the seal.

Improved reliability, reduced costs of manufacture, and a direct-seal pressure joint of flexibility and strength are among the advantages of this device.

Source: Royal C. Englehart, Jr. of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-476)

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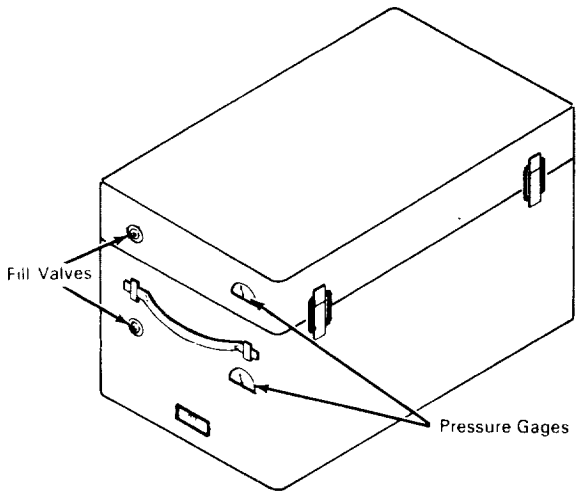
REUSABLE AIR-CUSHIONED SHIPPING CRATE



The shipping crate described here is interlined with molded rubber bladders that provide positive shock protection in all directions for the item being shipped. In effect, the item is completely surrounded by a minimum of 4 inches of compressed air. The bladders can be molded into a standard size and shape, so that several items of varied sizes, shapes, and weights can be packed with supplemental soft filler, such as cellulosic cushioning material. To accommodate items of similar size and shape, the bladders can be molded to fit individual items. Fill valves are accessible from outside the crate for initial filling of the bladders and for supplementing pressure during shipment, if required. Pressure gauges, visible from outside the crate, can be checked before each movement of the crate. These gauges are optional because pressures can be measured from the fill valves.

This innovation should be useful to manufacturers of products susceptible to breakage (for example, electronic and optical devices). In addition it would be effective for airdrop on land and even on water because of the buoyancy of the package. The container also could be used for transporting explosives such as nitroglycerin.

Source: Cameron A. Long of
North American Aviation, Inc.
under contract to
Marshall Space Flight Center
(MFS-12775)

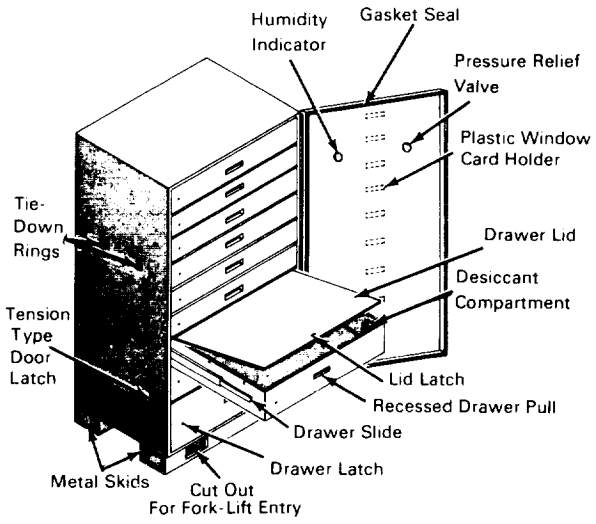
Circle 12 on Reader's Service Card.

ENVIRONMENTALLY CONTROLLED REUSABLE CONTAINER FOR SHIPPING AND STORAGE

An environmentally controlled, hermetically sealed, reusable metal cabinet with storage drawers has been designed for shipping and storing fragile mechanical and electronic parts and medical supplies under extreme weather and rough handling conditions. The cabinet, 30 × 24 × 72 in. in size, is constructed of steel. A 30% reduction in weight can be achieved, however, if it is made of aluminum. Advantages of this device over normal methods of packaging with disposable

material include lower costs and reduced time required for visual inspection of shipments.

The cabinet door is removable and can be hinged on either the right or left side. It is fitted with a gasket and is secured by four tension-type latches to provide an airtight vapor-proof seal. A humidity indicator, a pressure relief valve, and plastic window cardholders designating the contents of the drawers are mounted on the door panel.



The drawers of the cabinet are removable, and are lined and fitted with polyurethane dividers to protect the contents from abrasion and shock. Each drawer has a compartment for desiccants, a lid or cover, and a latch to secure it in place.

Two metal skids of ten-inch channel are welded to the bottom of the cabinet. Slots are cut in the skids allowing access to fork lifts from front, rear, and both sides of the cabinet. Recessed tie-down rings are provided to secure the cabinet during shipment.

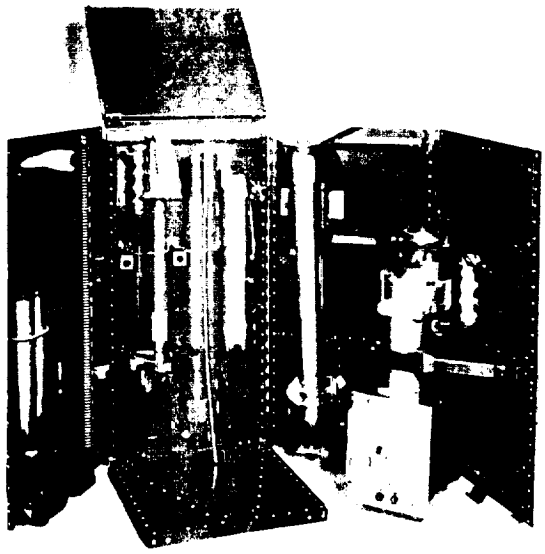
The cabinet is designed to protect its contents in temperatures ranging from - 20° to +140°F, humidity up to 100%, and mechanical shock equivalent to that caused by dropping the cabinet, when loaded with 100 lb./drawer, from a height of 12 in. onto a concrete surface.

Source: K. R. Kummerfeld of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-90703)

Circle 13 on Reader's Service Card.

REVERSIBLE TOOL CHEST

A novel tool chest has been developed to transport tools for collecting samples of the lunar surface, and, in its reversible configuration, for stowing the samples to be returned to earth. The tools and accessories are mounted on brackets attached to the inner walls of the container, and are located for optimum center of gravity with high-use items near the top. The chest is so constructed that it can be folded inside out by simply removing a single hinge pin, thus making the bracketed tools readily accessible and the interior space quickly available for the temporary stowage of specimens. The four side panels are of aluminum or other lightweight material stiffened with angles, and are interconnected with piano hinges. The top and bottom panels are similarly constructed and interconnected with the side panels. The bottom has three legs which project



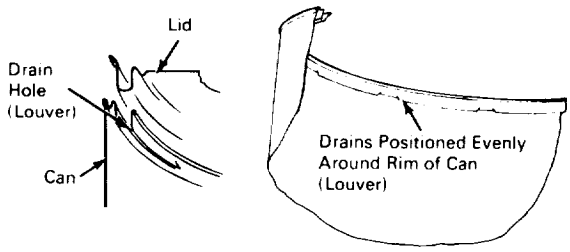
into the chest when it is closed. When it is open, the legs serve to raise the chest 4 inches, making the tools easily accessible and providing a stable base for the entire assembly. The top can be used as a base for the erection of survey instruments and as a table for resting miscellaneous apparatus. The entire assembly is portable and can be fitted with wheels or skids, if desired.

This assembly would be ideal for use by TV repairmen and telephone and electrical workers. It should also be useful to people engaged in such activities as mining and archaeological and geological exploration.

Source: Donald Frederick Malzahn of
Martin-Marietta Corp.
under contract to
Manned Spacecraft Center
(MSC-90901)

No further documentation is available.

LOUVERED-LIP DRAINS FOR CONTAINERS: A CONCEPT



Self-contained drains in the grooved lips of containers of liquids and semiliquids would enable excess material to drain back into the containers. At present, most containers of such liquids as chemicals, paints, and resins are sealed by lids with circular grooves. If a container is opened and used, excess material, such as brush drippings, fills the groove and, when the lid is replaced, the contents drip or spatter. In the case of harmful chemicals, such spattering can be dangerous to personnel.

This innovation would consist of four curved louvers stamped circumferentially in the lip of the container during its manufacture. The lid would have a two-tiered tongue with the four deeper portions of the tongue designed to fit the louvered sections of the lip, as illustrated in the sketch. Both air tightness and drainage could be provided by this inexpensive technique.

Source: Lawrence J. Pierce of
North American Rockwell Corp.
under contract to
Marshall Space Flight enter
(MFS-16536)

No further documentation is available.

FOR FURTHER INFORMATION

Use attached Reader Service Card. Circle key numbers to identify items for which additional information is desired, and mail.

OTHER TECHNOLOGY UTILIZATION PUBLICATIONS

These describe technology, derived from NASA's activities, that may have utility in nonaerospace applications. Publications include: Tech Briefs, Surveys, Handbooks, Reports, Technical Notes, Conference Proceedings, Special Studies, and Selected Bibliographies. (Details on their availability may be obtained from the address on the reverse of this Card.)

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READER SERVICE CARD

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